Application No. 10/092,033
Filed: March 5, 2002
TC Art Unit: 3739
Confirmation No.: 7761

AMENDMENT TO THE CLAIMS

1. (Currently Amended) A fluorescence imaging endoscope system comprising:

a diode laser light source for producing excitation light having a wavelength in the range of 300 to 420 nm that induces visible fluorescence in tissue and a second light source for producing a reference light including red, green and blue wavelength bands;

an optical combiner that optically couples said excitation light and said reference light onto a common optical path, said ~~combined~~ excitation light and reference light being coupled into an optical guide that delivers the ~~combined~~ light to the tissue through an endoscope;

a single image detector at a distal end of the endoscope that detects ~~a~~ an autofluorescence image and a reference image of the tissue; and

a data processor that processes the autofluorescence image and said reference image to produce a processed output image of the tissue.

2. (Previously Presented) The system of Claim 1 wherein the processed output image comprises a visible light image and a



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color overlay indicative of a predetermined level of fluorescence intensity.

3. (Previously Presented) The system of Claim 2 wherein the single image detector is a charge coupled device detector.

4. (Previously Presented) The system of Claim 1 wherein the optical guide is a fiberoptic bundle extending through a channel of the endoscope to measure dysplasia in a colon or lung of a subject.

5. (Currently Amended) The ~~method~~ system of Claim 1 wherein the detector at a distal end of the endoscope ~~compromises~~ comprises a color charge coupled device.

6. (Previously Presented) The system of Claim 1 wherein the excitation light and the reference light are emitted sequentially such that the image detector comprises a monochromatic image sensor that detects a fluorescence image during a first time period and detects a reflected image during a second time period.



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7. (Previously Presented) The system of Claim 1 wherein the excitation light and the reference light are emitted simultaneously such the respective images are detected by a color-sensitive image detector, a blue channel detecting the fluorescence image and a red channel detecting the reference image.

8. (Previously Presented) The system of Claim 1 wherein the excitation light is in the range of 380 to 420 nm.

9. (Previously Presented) The system of Claim 1 wherein the second light source further comprises a reference light source having a wavelength in an infrared range.

10. (Original) The system of Claim 1 wherein the optical guide comprises an optical fiber with a distally mounted lens.

11. (Previously Presented) The system of Claim 1 wherein the excitation light has an angular distribution that is the same as an angular distribution as the reference light.

12. (Withdrawn) A method for imaging tissue fluorescence comprising:



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providing excitation light with a first wavelength;

providing a reference light having a second wavelength;

detecting a fluorescence image of the tissue due to said excitation light and a reference image of the tissue due to reflected light; and

processing said fluorescence image together with said reference image to produce an output image of the tissue comprising the steps of:

correcting the fluorescence image and the reference image for video gamma factor;

normalizing the intensity level of the fluorescence image and the reference image;

generating a ratio image of the fluorescence image and a corrected reference image; and

determining if the ratio image falls below a predetermined threshold value indicative of the presence of a region of dysplasia.

13. (Withdrawn) The method of Claim 12 further comprising providing an arc lamp light source.

14. (Withdrawn) The method of Claim 13 further comprising pulsing a current source of the arc lamp.



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15. (Withdrawn) The method of Claim 12 further comprising sequentially directing the excitation light and reference light onto the optical path and detecting the images with a monochromatic image sensor.

16. (Withdrawn) The method Claim 12 further comprising simultaneously emitting the excitation light;

and detecting images with color-sensitive image sensor, the sensor having a blue channel detecting an autofluorescence image and a red channel detecting the reference image.

17. (Withdrawn) The method of Claim 12 further comprising coupling the excitation light and the reference light to an optical fiber such that a variation in a normalized intensity of the reference light and a normalized intensity of the excitation light is less than 20% at any point in a wavefront along the optical path between a combiner that combines the excitation light and the reference light and a tissue surface.

18. (Withdrawn) A method for imaging tissue fluorescence comprising:



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providing excitation light having a wavelength in a range of 300 nm to 420 nm;

providing a reference light having a wavelength in a visible red range;

combining said excitation light and said reference light onto a common optical path;

detecting a fluorescence image of the tissue due to the said excitation light and a reference image of the tissue due to reflected reference light with a color imaging sensor at a distal end of an endoscopic probe; and

processing said fluorescence image and said reference image to produce an output image of the tissue, wherein the reference image is used to normalize the fluorescence image to quantify local reductions in fluorescence intensity.

19. (Withdrawn) The method of Claim 18 further comprising determining a ratio of the fluorescence image and the reference image to provide the processed image.

20. (Withdrawn) The method of Claim 18 further comprising adjusting the relative intensity or angular distribution of the reference light relative to the excitation light.



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21. (Previously Presented) The system of Claim 1 wherein the single image detector further comprises a pixellated integrated circuit device.

22. (Previously Presented) The system of Claim 1 wherein the single image detector further comprises a CMOS imaging device.

23. (Previously Presented) The system of Claim 1 wherein the diode laser light source comprises gallium nitride laser diodes.

24. (Previously Presented) The system of Claim 23 wherein the gallium nitride laser diodes operate at wavelengths in the range of 380 nm to 420 nm.

25. (Previously Presented) The system of Claim 1 wherein the second light source is an arc lamp.

26. (Previously Presented) The system of Claim 1 wherein the second light source is a mercury arc lamp.



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27. (Withdrawn) The method of Claim 12 further comprising providing a diode laser light source for providing excitation light.

28. (Withdrawn) The method of Claim 12 wherein the step of normalizing the reference image comprises a histogram-based normalization.

29. (Withdrawn) The method of Claim 18 wherein the step of processing comprises the steps of:

correcting the fluorescence image and the reference image for video gamma factor;

normalizing the intensity level of the fluorescence image and the reference image;

generating a ratio image of the fluorescence image and a corrected reference image; and

determining if the ratio image falls below a predetermined threshold value indicative of the presence of a region of dysplasia.

30. (Withdrawn) The method of Claim 18 wherein the output image further comprises a color overlay indicative of a predetermined level of fluorescence intensity.



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31. (Withdrawn) The method of Claim 18 further comprising providing a diode laser light source for providing excitation light.

32. (Withdrawn) The method of Claim 31 wherein the diode laser light source comprises a solid state gallium nitride laser diode.

33. (Withdrawn) The method of Claim 32 wherein the gallium nitride laser diode operates at wavelengths in the range of 380 nm to 420 nm.

34. (Withdrawn) The method of Claim 18 further comprising providing an arc lamp for providing a reference light.

35. (Withdrawn) The method of Claim 34 wherein the arc lamp is a mercury arc lamp.



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